Satoshi AOKI, et al.   Q91816
CONTROL SYSTEM UTILIZING SERIAL
COMMUNICATION
Filing Date: February 7, 2006
Richard C. Turner   202-293-7060
Applicant's Comments 1 of 1

10/567460

COMMENTS

B1   H06-14040

Disclosed is a technology that relates to a method of transmitting a warning from a principal apparatus to terminal apparatuses in the case where the principal apparatus and the terminal apparatuses are connected to a ring-shaped network, and that has a function in which only a designated apparatus can receive a warning.

B2   H08-328636

What is disclosed relates to a controlling method for a control system in which a principal control apparatus and a plurality of distributed remote-I/O units are connected through a serial communication system, and in which one-to-N communication is implemented between the principal control apparatus and distributed remote-I/O units.

B3   H01-141442

Disclosed is a technology, related to serial data communication utilizing light, that has a function in which, in the case where the amount of light received by a terminal apparatus is abnormal, the terminal apparatus has a means for writing in information on the abnormality and the principal apparatus receives the information.

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TRANSLATION

B4   H11-231923

(Translation of sections[0027]-[0029], which were identified as relevant passage in ISP)

[0027]

Fig. 3 is a block diagram for connecting a configuration of an I/O unit 4. In Fig. 3, the I/O unit 4 includes a parallel/serial converting unit 4C for signal-converting a parallel signal from the machine into a serial signal, an error-code adding unit 4B for adding an error code to the converted serial signal, and a transmission/reception control unit 4A for directly communicating to a signal line 8.

[0028]

The error-code adding unit 4B is a means for adding to data an error code utilized to detect an error in transmitted data, in the transmission/reception control means 3 in the numerical control system 1. In addition, as the error code, a well-known error-detection code may be utilized.

[0029]

The transmission/reception control unit 4A is a means for controlling giving to and receiving from the signal line 8 data and a control signal, and is utilized also as a relaying means for transmitting to the numerical control system 1 data sent from the adjacent I/O unit 4 or a communication control unit 5, or for transmitting to the adjacent I/O unit 4 a control signal sent from the numerical control system 1.

B5   H02-235146

(Translation of ll.12-18, lower right column of page 21, which was identified as relevant passage in ISP)

(3) frame error

This denotes an error in the case where there is an error in a frame logic, e.g., in the case where, due to a cutoff, data having bytes corresponding to a normal frame has not been received.

It is checked if a communication error such as this has continued, for example, three times or more; if such is the case, it is considered that there has been a channel error.

B6   2002-329284

(Translation of sections[0027]-[0029], which were identified as relevant passage in ISP)

[0012]

[Embodiment]

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An embodiment of the present invention will be explained hereinafter with reference to the drawings.

Fig. 1 is a block diagram illustrating an embodiment of a sensor system and a numerical control system, according to the present invention. Here, constituent elements that are configured in the same way as those in Fig. 4 are will be indicated by the same reference numerals, and detailed explanations for them will be omitted.   Inside a host control apparatus 20, a random-number generator 18 generates through pseudo-random-number calculation a 16-bit error-ascertainment numerical value RND that is different from previous one. A host control computer 22 inputs with a specific time period to the transmission circuit 11 an error-ascertainment numerical value RND from the random-number generator 18 and obtained positional instruction data PO. The transmission circuit 11 converts data including the positional instruction data PO and the error-ascertainment numerical value RND into a serial signal HTX and transmits the data to a servo control system 13.

[0013]

The servo control system 13 transmits transmission data, as a serial signal STX, created by adding the error-ascertainment numerical value RND to a positional-data request instruction, to an absolute-type rotary encoder 21 that is a sensor system for detecting the position of the pivotal axle of the motor 2, with a time period shorter than that of the transmission cycle for the positional instruction data. Fig. 2 illustrates a transmission-frame structure of the positional-data request instruction.

[0014]

Inside the rotary encoder 21, when a reception circuit 8 receives the positional-data request instruction from the servo control system 3 and the error-ascertainment numerical value RND, a sensor control computer 17 inputs to a functional calculator 16 the error-ascertainment numerical value RND and detected data, i.e., 40-bit positional data PS and 8-bit status data STS. The functional calculator 16 outputs an error-ascertainment code SED that is an exclusive-OR of 16-bit addition data, obtained by adding three times, i.e., each 16 bits of 48-bit data consisting of the positional data PS and the status data STS, and the 16-bit error-ascertainment numerical value RND. The sensor control computer 17 inputs to a transmission circuit 9 position-detection data information created by further adding destination-address data DA that denotes the servo control system 3 and address data SA that denotes a transmission-source address to 64-bit data that is a combination of the 40-bit positional data, the 8-bit status data STS, and the 16-bit error-ascertainment code SED. The transmission circuit 9 transmits the inputted data, as a serial signal SRX, to the servo control system 13. Fig. 3 illustrates a transmission-frame structure, in this situation.

[0015]

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When receiving the transmission frame from the rotary encoder 21, the servo control system 13, as is the case with a conventional system, carries out current control of motor currents UVW, speed control, and positional control, based on the positional data PS in the transmission frame. In addition, the servo control system 13 converts the 40-bit positional data, the 8-bit status data STS, 16-bit error-ascertainment code SED, from the rotary encoder 21, into a serial signal HRX and transmits the serial signal to the host control apparatus 20.   The host control computer 22 inputs to a functional calculator 19 the 40-bit positional data, the 8-bit status data STS, and the error-ascertainment numerical value RND that the host control computer 22 has transmitted. The functional calculator 19 outputs a reception-side calculated value SEC, by implementing the same calculation as the functional operator 16 in the rotary encoder 21 does.   The host control computer 22 compares the reception-side calculated value SEC with the received error-ascertainment code SED, thereby monitoring abnormality of the position-detection data.   The abnormality of the position-detection data can be detected from the difference value between the reception-side calculated value SEC and the received error-ascertainment code SED. Additionally, a malfunction in the operation of the sensor control computer 17 or the like in the rotary encoder 21 can also be detected.

[0016]

In the foregoing description, the functions of the random-number generator 18 and the functional calculators 16 and 19 may be realized as hardware; however, depending on software types for the host control computer 22 and the sensor control computer 17, the functions can be realized by software processing, whereby hardware for implementing the functions is not required.

[0017]

In addition, in the present embodiment, the calculation processing by the functional calculators is the combination of addition and exclusive-OR; however, by combining calculation for obtaining a CRC code through a generator polynomial with that calculation processing, the ability in detecting abnormality can further be raised. Moreover, by utilizing a calculating technology for encoding, the sensor systems may output encoded positional data only. In such abnormality detection, if abnormality exists in the encoded data, a significant difference is produced between the decoded positional data and the previous positional data; therefore, the abnormality can be detected. Still moreover, in the present embodiment, the functional calculation between the error-ascertainment numerical value RND and all of the position-detection data PS has been implemented; however, the functional calculation may be implemented only between the error-ascertainment numerical value RND and a part of positional data such as one-turn rotation information. Furthermore, as a numerical-value generator for generating a different numerical value every specific time, a random-number

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generator has been described as an example; however, a different numerical value may be generated by such a counter as simply counts up a numerical value.   In the last place, the present invention is not limited to a sensor system that is a rotary encoder, but can also be applied to a sensor system utilizing a sensor that can detect physical quantity such as speed or temperature.